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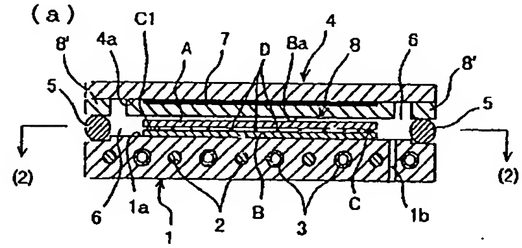
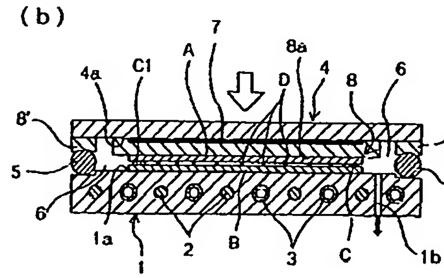
(54)【発明の名称】　液晶パネル製造装置

(57)【要約】
【課題】　定盤から素早く基板の全体へ均一に熱伝導可能する。
【解決手段】　定盤1を剛性が高くて基板A，Bと同程度の熱膨張率を有する耐熱性材料で一体的に形成することにより、熱による変形が発生せずに形状保持されると共に、その内部に加熱手段2と冷却手段3を平面的に密な状態でしかも互いに接近させて埋設することにより、加熱手段2の作動で該定盤1の加圧面1a全体が均一に急速加熱され、冷却手段3の作動で急速冷却される。

(a)


(b)


【特許請求の範囲】

【請求項1】　精度良く貼り合わされた2枚の基板(A，B)を定盤(1)上にセットし、その精度のままで基板(A，B)を加圧して所定のギャップまで潰しながら、上記定盤(1)の加熱手段(2)により加熱して、両基板(A，B)間の熱硬化性接着剤(C)を硬化させる液晶パネル製造装置において、

前記定盤(1)を剛性が高くて基板(A，B)と同程度の熱膨張率を有する耐熱性材料で一体的に形成し、その内部に加熱手段(2)と冷却手段(3)を平面的に密な状態でしかも互いに接近させて埋設したことを特徴とする液晶パネル製造装置。

【請求項2】　前記定盤(1)の上下中間位置に直線状の加熱手段(2)と冷却手段(3)を交互に接近させて配置した請求項1記載の液晶パネル製造装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、液晶ディスプレイ(LCD)に使用する液晶パネルの製造装置に関する。詳しくは、精度良く貼り合わされた2枚の基板を定盤上にセットし、その精度のままで基板を加圧して所定のギャップまで潰しながら、上記定盤の加熱手段により加熱して、両基板間の熱硬化性接着剤を硬化させる液晶パネル製造装置に関する。

【0002】

【従来の技術】従来、この種の液晶パネル製造装置として、例えば特許第2934438号公報に開示される如く、定盤が上層部材と下層部材に2分割されて、その上層部材には冷却手段を埋設し、下層部材には加熱手段を装備したものがある。このものは、基板の加圧状態で、下層部材の加熱手段を作動させることにより、下層部材からの熱伝導で上層部材を介して基板が加熱され、加熱成形後の冷却時は上層部材から下層部材を切り離すことにより、上層部材を急速冷却している。

【0003】

【発明が解決しようとする課題】しかし乍ら、このような従来の液晶パネル製造装置では、上層部材と下層部材の接合面を介して下層部材からの熱が上層部材を経て基板に伝えるため、上層部材と下層部材の接合面を完全な平坦に加工して全面的に面接触できれば上層部材及び基板の全体を均一に伝熱できるが、上下接合面を夫々完全な平坦に加工するのは困難な作業であって製作コストが高額になるという問題がある。特に基板の大型化に伴って定盤の上層部材及び下層部材を大型化する必要がある場合には、これら上下接合面を完全な平坦に加工するのは非常に困難となり、これら接合面に僅かな凹凸が発生すれば、部分的に接触する箇所と不接触な箇所ができ、部分的に接触する箇所から先に熱伝導して不接触な箇所は熱伝導が遅れてしまい、基板の全体を均一に加熱し難いと共に、熱伝達するまでに時間を要して熱応答性に劣り、その結果として温度コントロールが難しいという問題がある。

【0004】本発明のうち請求項1記載の発明は、定盤から素早く基板の全体へ均一に熱伝導可能することを目的としたものである。請求項2記載の発明は、請求項1に記載の発明の目的に加えて、温度変化による定盤の変形を完全に防止することを目的としたものである。

【0005】

【課題を解決するための手段】前述した目的を達成するために、本発明のうち請求項1記載の発明は、定盤を剛性が高くて基板と同程度の熱膨張率を有する耐熱性材料で一体的に形成し、その内部に加熱手段と冷却手段を平面的に密な状態でしかも互いに接近させて埋設したことを特徴とするものである。請求項2記載の発明は、請求項1記載の発明の構成に、前記定盤の上下中間位置に直線状の加熱手段と冷却手段を交互に接近させて配置した構成を加えたことを特徴とする。

【0006】

【作用】請求項1の発明は、定盤を剛性が高くて基板と同程度の熱膨張率を有する耐熱性材料で一体的に形成することにより、熱による変形が発生せずに形状保持されると共に、その内部に加熱手段と冷却手段を平面的に密な状態でしかも互いに接近させて埋設することにより、加熱手段の作動で該定盤の上面全体が均一に急速加熱され、冷却手段の作動で急速冷却されるものである。請求項2の発明は、請求項1記載の構成に対して、前記定盤の上下中間位置に直線状の加熱手段と冷却手段を交互に接近させて配置した構成を追加したので、加熱手段及び冷却手段を挟んで定盤の上半部と下半部が同条件となり、加熱及び冷却によって定盤の上半部と下半部に温度差ができない。

【0007】

【発明の実施の形態】以下、本発明の実施例を図面に基づいて説明する。この実施例は、図1～図2に示す如く、大気中で精度良く貼り合わされた2枚のガラス製基板A，Bを定盤1上にセットし、上蓋4を下降して環状シール材5に接触させることにより、定盤1と上蓋4との間に環状シール材5で囲まれた閉空間6を形成し、この閉空間6内の減圧により、上蓋4が大気圧で押し下げられ緩衝材7を介して基板A，Bが加圧されるものである。

【0008】上記定盤1は、剛性が高くて基板A，Bと同程度の熱膨張率を有する耐熱性材料、例えばカーボンなどで一体的に形成され、その内部に埋設した加熱手段2で加熱したり、冷却手段3で冷却しても簡単に変形しない厚さ寸法に形成する。

【0009】これら加熱手段2と冷却手段3は、平面的に密な状態でしかも互いに接近させて埋設する。本実施例の場合には、図1及び図2に示す如く定盤1の上下中間位置に、直線状の加熱手段2及び冷却手段3を水平方

向へ所定ピッチ、例えば50～60㎜で交互に接近させて夫々複数本ずつ平行に配置し、加熱手段２としては通電により発熱する線状ヒーターを使用し、冷却手段３としては冷却水が通る冷却パイプを使用している。

【００１０】また、定盤１の中央部分に比べて外周部分の方は、放熱されて冷え易いため、中央部分の加熱温度より外周部分の加熱温度が高くなるように上記加熱手段２を温度設定して、定盤１の加圧面１ａ全体が均一温度となるように制御することも可能である。

【００１１】更に、上記定盤１の加圧面１ａには、後述する上蓋４の加圧面４ａと対向して例えばＯリングなどの環状シール材５が取り付けられ、この環状シール材５の内側には、図示しない枠などの位置決め手段を介して、例えば所望のパターンが形成されたカラーフィルターとＴＦＴ基板からなる２枚の基板Ａ，Ｂが定位置にセットされる。これら環状シール材５と基板Ａ，Ｂとの空間に連通するように吸引通路１ｂを定盤１に開設し、この吸引通路１ｂによって環状シール材５の内側から吸引排気するように構成している。

【００１２】前記基板Ａ，Ｂは、その一方の基板に熱硬化性樹脂からなる接着剤Ｃを、その一部が液晶注入孔Ｃ１として開口する枠状に塗布し、他方の基板には多数のスペーサＤを散布した後、大気中で精度良く位置合わせして貼り合わされる。図１～図２に示したものは、接着剤Ｃによる枠が一つしか存在しないが、これに限定されず、基板Ａ，Ｂが大型であれば、その間に接着剤Ｃの枠を複数配置させることもできる。

【００１３】一方、前記上蓋４は、例えばカーボンなどの剛体で構成し、図示しない例えば駆動シリンダーなどの昇降機構により往復動自在に支持されるが、少なくとも該上蓋４を下降させて環状シール材５に接触した以降は、上記昇降機構との連係を解放して自由に昇降できるようにしている。

【００１４】また、この上蓋４の加圧面４ａには、加熱・冷却手段７を配設し、この加熱・冷却手段７の熱を逃がさないように、該上蓋４自体を断熱性に優れた材料で形成するか、或いは図示せぬが、これら上蓋４の加圧面４ａと加熱・冷却手段７との間に断熱材を介在させる。加熱・冷却手段７としては、本実施例の場合、通電により発熱する面状ヒーターと、冷却水が通る複数の冷却パイプが内蔵された金属板とを一体的に積層して構成している。

【００１５】更に、この上蓋４の加圧面４ａには、加熱・冷却手段７を覆って基板Ａ，Ｂと当接する緩衝材８が固着される。この緩衝材８は、両基板Ａ，Ｂ間の接着剤Ｃを硬化させるため耐熱性（１００℃以上）に優れた例えばシリコン発泡ゴムやそれより耐久性に優れた材料などで構成される。その厚さ寸法は、前記上蓋４の加圧面４ａが環状シール材５に接触した時点では、図１（ａ）に示す如くその先端面８ａが基板Ａ，Ｂの上端面と間隙を介して不接触であると共に、上記環状シール材５Ｃに囲まれた閉空間６内の減圧により、上蓋４が大気圧で押し下げられた時には、図１（ｂ）に示す如く先端面８ａを基板Ａ，Ｂの上端面に接触させて圧縮変形するように設定する。

【００１６】本実施例では、環状シール材５Ｃと対向する上蓋４の加圧面４ａ周縁部には、環状シール材５Ｃより柔らかい緩衝材８′を配設し、閉空間６内の減圧により上蓋４が大気圧で押し下げられた際には、環状シール材５Ｃより先に周縁緩衝材８′が圧縮変形して上記緩衝材８の先端面８ａを基板Ａ，Ｂの上端面に接触させて圧縮変形するように設定している。なお、これに限定されず、上蓋４が大気圧で押し下げられることに伴って環状シール材５Ｃが潰れる範囲内で、上記緩衝材８の先端面８ａを基板Ａ，Ｂの上端面に接触させて圧縮変形できれば、周縁緩衝材８′に代えて剛体からなる突起部を上蓋４と一体的に形成しても良い。

【００１７】次に、斯かる液晶パネル製造装置の作動について説明する。先ず、初期状態で定盤１は、接着剤Ｃに影響を与えない温度、例えば６０℃以下に保っておき、上蓋４を上昇させて、基板Ａ，Ｂを定盤１上にセットする。このセットが終了した後は、図１（ａ）に示す如く上蓋４を重力又はシリンダー駆動により下降させて環状シール材５に接触し、それにより、上蓋４と定盤１との間に環状シール材５で囲まれた閉空間６が形成される。

【００１８】その後、定盤１の吸引通路１ｂから吸引排気を開始して、上記閉空間６内を減圧させる。それにより、図１（ｂ）に示す如く上蓋４が大気圧で徐々に押し下げられ、緩衝材８の先端面８ａが基板Ａ，Ｂに圧接して圧縮変形する。その結果、上蓋４の加圧面４ａの平面度と関係なく、上蓋４の加圧面４ａと基板Ａ，Ｂの上端面との間の厚みむらが平均化される。従って、基板Ａ，Ｂを完全な平行状態に保ちながら所定のギャップまで確実に押圧できる。

【００１９】また、閉空間６の減圧に伴って両基板Ａ，Ｂの間に残った空気、詳しくは、接着剤Ｃにより囲まれた液晶封入用空間Ｃ２内に残った空気が、該接着剤Ｃの一部に開口した液晶注入孔Ｃ１から抜き出される。従って、液晶封入用空間Ｃ２内に残った空気が基板Ａ，Ｂの加圧に対する反力とならず、所定ギャップまでスムーズに潰せる。

【００２０】そして、これら基板Ａ，Ｂが所定ギャップ近くまで潰れた時点で、定盤１の加熱手段２と上蓋４の加熱・冷却手段７に通電し、均一に基板Ａ，Ｂの温度を上げ、接着剤Ｃを軟化させて所定のギャップを出し、硬化するまで温度コントロールを行う。

【００２１】この際、定盤１を剛性が高くて基板Ａ，Ｂと同程度の熱膨張率を有する耐熱性材料で一体的に形成したから、熱による変形が発生せずに形状保持されると

共に、その内部に加熱手段２を平面的に密な状態でしかも互いに接近させて埋設したから、定盤１の加圧面１ａ全体が均一に急速加熱される。従って、定盤１から素早く基板Ａ，Ｂの全体へ均一に熱伝導できる。

【００２２】上記接着剤Cの硬化が終了した後は、定盤１の吸引通路１ｂからの吸引排気を停止させ、定盤１の冷却手段３と上蓋４の加熱・冷却手段７の冷却パイプに夫々通水して水冷し、その後、上蓋４を上昇して基板Ａ，Ｂを取り出し、それ以降は上述した作業を繰り返す。

【００２３】一方、図3と図4に示すものは、夫々が本発明の他の実施例である。図３のものは、前記定盤１の加熱手段２が多数の線状ヒーターではなく面状ヒーターであり、これを定盤１の上下中間位置に配置すると共に、これの上下どちらか一方に冷却手段３として冷却パイプを水平方向へ所定ピッチ毎に複数本配置した構成が、前記図１～図２に示した実施例とは異なり、それ以外の構成は図１～図２に示した実施例と同じものである。

【００２４】従って、図3に示すものは、前記図１～図２に示した実施例よりも発熱源の隙間ができないので、基板Ａ，Ｂの全体を更に均一に加熱できると共に、多数の線状ヒーターを配置するのに比べて構造が簡素化して製造コストを低減できるというという利点がある。

【００２５】図4のものは、前記上蓋４の構造が特許第２９３４４３８号公報に記載されるようなヒーター付反射板７′を内蔵した中空構造とすると共に基板Ａ，Ｂと当接する加圧面が基板Ａ，Ｂと同程度の熱膨張率を有する可撓性フィルム９である構成が、前記図１～図２に示した実施例とは異なり、それ以外の構成は図１～図２に示した実施例と同じものである。

【００２６】従って、図4に示すものも、前記図１～図２に示した実施例と同様に、定盤１から素早く基板Ａ，Ｂの全体へ均一に熱伝導できることに変わりない。

【００２７】尚、前示実施例では、基板Ａ，Ｂを定盤１上にセットし、上蓋４を下降して環状シール材５に接触させることにより閉空間6を形成し、この閉空間6内の減圧により、上蓋４が大気圧で押し下げられ緩衝材７を介して基板Ａ，Ｂが加圧される場合を示したが、これに限定されず、基板Ａ，Ｂを加圧して所定のギャップまで潰しながら定盤１の加熱手段２により加熱して、両基板Ａ，Ｂ間の熱硬化性接着剤Cを硬化させる作用が得られれば、他の構造でも良い。更に、図１及び図２に示した実施例では、直線状の加熱手段２及び冷却手段３を夫々複数本ずつ平行に配置したが、これに限定されず、直線状の加熱手段２及び冷却手段３を夫々上下方向に離して複数本ずつ平面から見て交差するように配置しても良い。

【００２８】

【発明の効果】以上説明したように、本発明のうち請求項１記載の発明は、定盤を剛性が高くて基板と同程度の熱膨張率を有する耐熱性材料で一体的に形成することにより、熱による変形が発生せずに形状保持されると共に、その内部に加熱手段と冷却手段を平面的に密な状態でしかも互いに接近させて埋設することにより、加熱手段の作動で該定盤の加圧面全体が均一に急速加熱され、冷却手段の作動で急速冷却されるので、定盤から素早く基板の全体へ均一に熱伝導できる。従って、定盤の上下接合面に僅かな凹凸が発生した場合には部分的に接触する箇所から先に熱伝導して不接触な箇所は熱伝導が遅れる従来のものに比べ、基板の全面を均一に加熱できると共に熱応答性に優れて温度コントロールが容易である。この効果は特に基板の大型化に伴って定盤を大型化した場合に顕著に現れる。更に、定盤の上下接合面を完全な平坦に加工する従来のものに比べ、接合面を完全な平坦に加工する作業が必要ないから、定盤の製作コストを大幅に低減できる。

【００２９】請求項２の発明は、請求項１の発明の効果に加えて、加熱手段及び冷却手段を挟んで定盤の上半部と下半部が同条件となり、加熱及び冷却によって定盤の上半部と下半部に温度差ができないので、温度変化による定盤の変形を完全に防止できる。

【図面の簡単な説明】

【図１】　本発明の一実施例を示す液晶パネル製造装置の縦断正面図であり、（ａ）は減圧前の状態を示し、（ｂ）は減圧による基板の加圧時を示している。

【図２】　図１（ａ）の（２）－（２）線に沿える同横断平面図である。

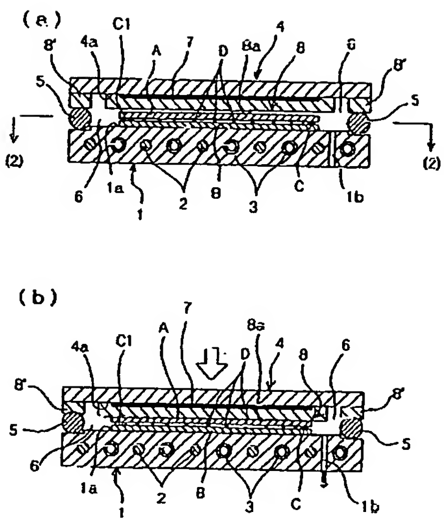
【図３】　本発明の他の実施例を示す液晶パネル製造装置の縦断正面図であり、減圧前の状態を示している。

【図４】　本発明の他の実施例を示す液晶パネル製造装置の縦断正面図であり、減圧前の状態を示している。

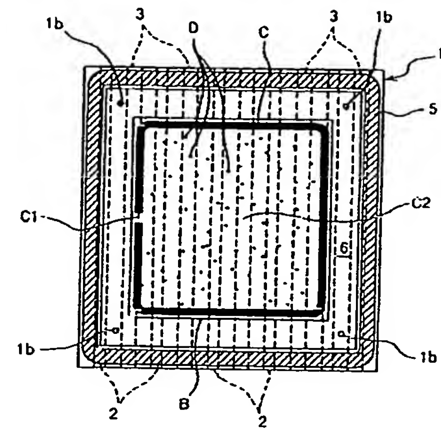
【符号の説明】

Ａ，Ｂ　基板　　C　接着剤
１　定盤　　２　加熱手段
３　冷却手段

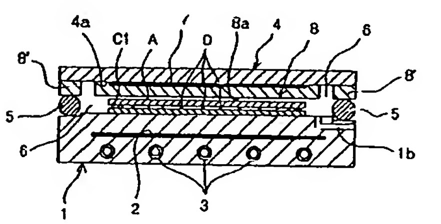
【図1】



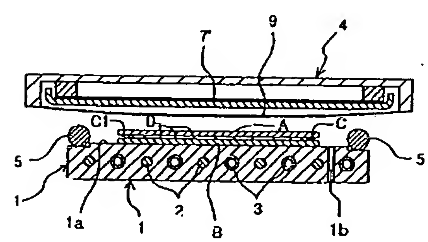
【図2】



【図3】



【図4】



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APPARATUS FOR FABRICATING LIQUID CRYSTAL PANEL

[Abstract]

PROBLEM TO BE SOLVED: To realize rapid and uniform conduction of heat from a surface board to the whole substrate.

SOLUTION: The surface board 1 is formed into one body from a heat- resistant material having high rigidity and an almost same coefficient of thermal expansion as that of substrates A, B, so that it maintains its form without causing deformation by heat. A heating means 2 and a cooling means 3 are embedded as two-dimensionally and densely arranged near to each other in the surface board, so that the whole pressurizing face 1a of the surface board 1 is uniformly and rapidly heated by operating the heating means 2 and is rapidly cooled by operating the

cooling means 3.

[Claims]

1. An apparatus for fabricating a liquid crystal display panel in which two substrates A and B which are bonded with high precision are set on a base plate 1, the substrates A and B are pressurized with the same high precision until a predetermined gap is formed therebetween, the substrates A and B are heated by a heating unit 2 of the base plate 1, and a thermosetting adhesive C between two substrates A and B is hardened, wherein the base plate 1 is formed of a heat resistant material having a heat expansion rate as same as that of the substrates due to its high rigidity, and the heating unit 2 and a cooling unit 3 are buried in the base plate 1 to be adjacent to each other in a dense state on a plane.

2. The apparatus of claim 1, wherein the linear heating units 2 and linear cooling units 3 are alternately arranged in the middle of the upper and the lower portions of the base plate 1.

[Title of the Invention]

APPARATUS FOR FABRICATING LIQUID CRYSTAL PANEL

[Detailed Description of the Invention]

[Field of the Invention]

The present invention is related to an apparatus for fabricating a liquid crystal display panel used in a liquid crystal display device, and more particularly, an apparatus for fabricating a liquid crystal display panel in which two substrates laminated with high precision are set on a base plate and pressurized with the same high precision downwardly until a predetermined gap is formed, the pressurized substrates are heated by a heating unit of the base plate, and a thermosetting adhesive between both the substrates is hardened

[Description of the Prior Art]

As disclosed in Patent No. 2934438 as such apparatus for fabricating a liquid crystal display panel in the prior art, for instance, a base plate is divided into an upper member and a lower member, wherein a cooling unit is buried in the upper member and a heating unit is installed in the lower member, which indicates that the heating unit of the lower member is operated in a state that the substrate is pressurized. That is, the substrate is heated by a heat conduction from the lower member, positioning the upper member between the substrate and the lower member. When performing a cooling after the heating operation, the lower member is divided from the upper member, thereby rapidly cooling the upper member.

[Problems to be Solved by the Invention]

However, in this prior art apparatus for fabricating a liquid crystal display panel, because heat is delivered to the substrate from the lower member via the upper member, positioning a bonded surface between the upper and lower members, if the bonded surface between the upper and lower members are perfectly leveled and thusly their whole surfaces are surface-contact therewith, the entire upper member and substrate can uniformly be heated. However, it is difficult to perform the leveling perfectly for the upper and lower bonded surface, which results in increase of fabrication cost. In particular, if the upper and lower members of the base plate should be larger as the substrate is larger, it is difficult to perfectly level the upper and lower bonded surface. As a result, when some concavo-convex is generated on this bonded surface, a partially-contact portion and a non-contact portion are generated, whereby heat is first conducted from the partially-contact portion and then to the lower member later. Accordingly, the entire surface of the substrate is hard to be heated uniformly, and a time for the heat transfer is required to thusly reduce a heat response, which results in difficulty in a temperature control.

The present invention according to claim 1 aims to enable a uniform heat conduction over the substrate rapidly from the base plate. The present invention according to claim 2 aims to perfectly prevent deformation of the base plate by a change of a temperature in addition to the object of the present invention according to claim 1.

[Means for Solving the Problem]

To solve those objects, the present invention according to claim 1 aims to

form a base plate which is made of a heat resistant material having a heat expansion rate as same as that of each substrate due to its high rigidity to thus be integral with the substrate, and to bury a heating unit and a cooling unit in the base plate to be adjacent to each other as a dense state in a plane. The present invention according to claim 2 adds a construction, in which the heating unit and the cooling unit of a linear shape are alternately approached and arranged in the middle of upper and lower portions of the base plate, to the construction mentioned in the present invention according to claim 1.

[Operation]

In the present invention according to claim 1, as a base plate is formed of a heat resistant material having a heat expansion rate as same as that of each substrate due to its high rigidity to be integral with the substrate, the base plate may not be deformed by heat. A heating unit and a cooling unit are buried in the base plate to be adjacent to each other as a dense state in a plane. As a result, the entire surface of the base plate is quickly and uniformly heated by the operation of the heating unit, to thereafter be quickly cooled by the operation of the cooling unit. In the present invention according to claim 2, a construction in which the heating unit and the cooling unit of a linear shape are alternately approached and arranged in the middle of upper and lower portions of the base plate is added to the construction disclosed in claim 1, whereby an upper portion and a lower portion of the base plate have the same condition by positioning the heating unit and the cooling unit therebetween, which results in preventing a difference of temperature between the upper and lower portions of the base plate.

[Embodiment of the Invention]

Hereinafter, an embodiment according to the present invention will be explained with reference to attached drawings.

In these embodiments as illustrated in Figures 1 and 2, two glass substrates bonded with high precision in the air are set on a base plate 1 and an upper cover 4 descends to be contact with a sealant 5. As a result, a closed space 6 surrounded by the annular sealant 5 is formed between the base plate 1 and the upper cover 4. By decompression within the closed space 6, the upper cover 4 can be pressed downwardly by atmospheric pressure to thus pressurize the substrates A and B, positioning a buffer therebetween.

The base plate 1 is formed of a heat resistant material (e.g., carbon) having a heat expansion rate as same as that of each substrate A and B due to its high rigidity to be integral with the substrates A and B and is as thick as not simply deformed by heating using the heating unit 2 and cooling using the cooling unit 3 buried therein.

These heating unit 2 and cooling unit 3 are buried to be adjacent to each other as a dense state in a plane. In the embodiments as illustrated in Figures 1 and 2, in the middle of the upper and lower portions of the base plate 1, a plurality of the linear heating units 2 and the linear cooling units 3 are alternately adjacent to each other at a predetermined pitch (e.g., 50 to 60 mm) in a longitudinal direction to be respectively parallel with each other. A linear heater radiating heat by being conducted is used as the heating unit 2. A cooling pipe through which a coolant passes is used as the cooling unit 3.

Compared with the center portion of the base plate 1, an outer edge portion is easy to be cooled by being radiated. Hence, the temperature of the

heating unit 2 is set such that the heating temperature at the outer edge portion is higher than that at the center portion, and thus a uniform temperature can be maintained over a pressurized surface 1a of the base plate 1.

Furthermore, an annular sealant 5 such as O-ring is mounted on the pressurized surface 1a of the base plate 1, facing a pressurized surface 4a of the upper cover 4. By using an aligning unit (not shown) such as a frame positioned inside the annular sealant 5, for instance, two substrates A and B including a color filter and a TFT substrate having a desired pattern are set in position. A suction passage 1b is installed in the base plate 1 so as to be communicated with a space between the substrates A and B and the annular sealant 5. Air can be sucked and exhausted from the inside of the annular sealant 5 through this suction passage 1b.

In the substrates A and B, one substrate is coated with an adhesive C formed of thermosetting resin along such frame shape, a part of which is open as a liquid crystal injection hole C1, while a plurality of spacers D are spread over the other substrate. Thereafter, the two substrates A and B are aligned with high precision in the air to be bonded with each other. As illustrated in Figures 1 and 2, there is only one frame by the adhesive C. However, it is not limited thereto, but a plurality of frames of the adhesive C can be arranged between the substrates A and B if the two substrate A and B have large sizes.

On the other side, the upper cover 4 is formed of a rigid body such as carbon. The upper cover 4 is supported by a lifting device (e.g., a driving cylinder although not shown) to thus be reciprocated. Though, after the upper cover 4 descends to be contact with the annular sealant 5, a link of the lifting device is released and thusly the upper cover 4 can move up and down free.

A heating/cooling unit 7 is installed on a pressurized surface 4a of the upper cover 4. In order to make the heat of the heating/cooling unit 7 be maintained, the upper cover 4 is formed of a material having superior thermal resistance, or a heat insulator (not shown) interposes between the pressurized surface 4a of the upper cover 4 and the heating/cooling unit 7. In the embodiment, the heating/cooling unit 7 is formed by integrally laminating a plate heater radiating by being conducted and a metal plate having a plurality of cooling pipes therein through which a coolant passes.

A buffer 8 is fixed to the pressurized surface 4a of the upper cover 4 so as to cover the heating/cooling unit 7 and be contact with the substrates A and B. This buffer 8 is formed of such silicon foam rubber having good durability (more than 100°C) or a material having durability superior to the silicon foam rubber so as to harden the adhesive C between both the substrates A and B. A thickness of the buffer 8 is set such that when the pressurized surface 4a of the upper cover 4 is contact with the annular sealant 5, as illustrated in Figure 1(a), a end surface 8a is not contact with an upper end surface of both the substrates A and B, positioning a space therebetween. Furthermore, the thickness of the buffer 8 is set such that when the upper cover 4 could be pressurized downwardly by decompression within a closed space 6 surrounded by the annular sealant 5 in atmospheric pressure, as illustrated in Figure 1(b), the end surface 8a is contact with the upper end surface of the substrates A and B to thusly be compressed and deformed.

In the present invention, another buffer 8' smoother than the annular sealant 5 is installed at a circumferential portion of the pressurized surface 4a of the upper cover 4 facing the annular sealant 5. When the upper cover 4 could be

pressurized downwardly by the decompression within the closed space 6, the buffer 8' at the circumferential portion is compressed and deformed prior to the annular sealant 5. Thereafter, the end surface 8a of the buffer 8 is contact with the upper end surface of the substrates A and B to thusly be compressed and deformed. It is not limited to this, but since the upper cover 4 can be pressurized in the atmospheric pressure, if the end surface 8a of the buffer 8 is contact with the upper end surface of the substrates A and B within the range in which the annular sealant 5 is pressurized downwardly to thusly be compressed and deformed, a protrusion replacing the buffer 8' and formed of a rigid body can integrally be formed with the upper cover 4.

Next, an operation of this apparatus for fabricating the liquid crystal display panel will now be described. First, in the initial state, the base plate 1 maintains a temperature which does not affect on the adhesive C, for instance, under a temperature of 60°C to lift the upper cover 4. The substrates A and B are set on the base plate 1. After completing this setting, as shown in Figure 1(a), the upper cover 4 is lifted down by gravitation or driving a cylinder to be contact with the annular sealant 5. As a result, the closed space 6 surrounded by the annular sealant 5 is formed between the upper cover 4 and the base plate 1.

Afterwards, suction and exhaust are initiated from the suction passage 1b of the base plate 1, and the inside of the closed space 6 is decompressed. Thus, as shown in Figure 1(b), since the upper cover 4 is slowly pressurized downwardly in the atmospheric pressure, the end surface 8a of the buffer 8 is pressurized on the substrates A and B to be compressed and deformed. As a result, regardless of a plane of the pressurized surface 4a of the upper cover 4, the thickness between the pressurized surface 4a of the upper cover 4 and the substrates A and B can be

uniform. Therefore, it is possible to precisely pressurize the substrates A and B downwardly until a predetermined gap is formed therebetween, maintaining the two substrates A and B in a completely parallel state.

Residual air between both the substrates A and B, namely, the residual air within a liquid crystal sealing space C2 surrounded by the adhesive C is removed through the liquid crystal injection hole C1, which is open in a part of the adhesive C, according to the decompression of the closed space 6. Therefore, the residual air within the liquid crystal sealing space C2 does not act as a reverse force against the pressure of the substrates A and B, and thus the substrates can smoothly be pressurized down to the predetermined gap.

At the time point that the substrates A and B are pressurized down near the predetermined gap, the heating unit 2 of the base plate 1 and the heating/cooling unit 7 of the upper cover 4 are conducted. Afterwards, the temperature of the substrates A and B is uniformly increased to soften the adhesive C, thereby forming the predetermined gap. Thereafter, until the adhesive C is re-hardened, the temperature is controlled.

At this time, since the base plate 1 is formed of a heat resistant material having a heat expansion rate as same as that of each substrate due to its high rigidity to thus be integral with the substrate, the base plate 1 is not deformed by heat but its shape is maintained. As well, since a heating unit and a cooling unit in the base plate 1 are buried to be adjacent to each other as a dense state in a plane, the entire pressurized surface 1a of the base plate 1 is uniformly heated with a fast speed. Therefore, heat can uniformly be conducted over the entire substrates A and B from the base plate with a fast speed.

After the adhesive C is completely hardened, the suction and exhaust

through the suction passage 1b of the base plate 1 is stopped. Water flows into the cooling unit 3 of the base plate 1 and a cooling pipe of the heating/cooling unit 7 to cool the water. Thereafter, the upper cover 4 is lifted and the substrates A and B are carried out, and then the aforementioned operations are repeated.

Figures 3 and 4 show different embodiments of the present invention, respectively. In Figure 3, the heating unit 2 of the base plate 1 is not a plurality of linear heaters but plate heaters. The plurality of plate heaters are aligned in a middle of upper and lower portions of the base plate 1. Furthermore, at a certain side of the upper and lower portions, a plurality of cooling pipes are arranged as the cooling unit 3 at a predetermined pitch in a longitudinal direction. Such construction is illustrated in the embodiment of the Figures 3 and 4 are different from those of Figures 1 and 2, while other constructions thereof are the same as those shown in the embodiments of Figures 1 and 2.

Therefore, since a gap of a heating source is rarely generated in the embodiment of Figure 3 as compared with embodiments of Figures 1 and 2, the entire substrates A and B can be heated more uniformly and the structure thereof can be simplified as compared with the structure of arranging a plurality of linear heaters to thus advantageously reduce fabrication cost.

In Figure 4, the structure of the upper cover 4 is the same as the structure disposing a heater attaching reflection board 7' therein disclosed in Japanese Patent No. 2934438, and also the pressurized surface being contact with the substrates A and B is a flexible film 9 having a heat expansion rate as same as that of each substrate A and B, of which construction is different from that shown in the embodiments of Figures 1 and 2, and other constructions thereof are the same as those shown in the embodiments of Figures 1 and 2.

Therefore, as in the embodiments shown in Figures 1 and 2, in the embodiment of Figure 4, heat can also be conducted over the entire substrates A and B from the base plate 1 with a fast speed.

In those aforementioned embodiments, the substrates A and B are set on the base plate 1, and the closed space 6 is formed by descending the upper cover 4 to be contact with the annular sealant 5. The upper cover 4 can be pressurized in the atmospheric pressure by the decompression within the closed space 6, and accordingly the substrates A and B can be pressurized, positioning the buffer 7 between the substrates A and B and the upper cover 4. However, this is not limited thereto. That is, if the substrates A and B are pressurized downwardly until the predetermined gap is formed while heating the base plate 1 by the heating unit 2, and the thermosetting adhesive C between both the substrates A and B can be hardened, other structure may be available.

Furthermore, in the embodiments shown in Figures 1 and 2, the plurality of linear heating units 2 and linear cooling units 3 are respectively arranged to be parallel to each other. However, this is not limited thereto. The plurality of linear heating units 2 and linear cooling units 3 are respectively divided in upper and lower directions to make each of them cross in a plane.

[Effect of the Invention]

As aforementioned, in the present invention according to claim 1, the base plate is formed of a heat resistant material having a heat expansion rate as same as that of the substrates due to its high rigidity to be integral with the substrates, and accordingly the base plate can be prevented form being deformed by heat. In addition, the heating unit and the cooling unit are buried in the base plate to be

adjacent to each other with a dense state in a plane, and accordingly the entire pressurized surface of the base plate can uniformly be heated with a fast speed by driving the heating unit and then cooled with a fast speed by the cooling unit. As a result, heat can uniformly be conducted from the base plate over the entire substrates. Therefore, even if some concavo-convex is generated on the upper and lower bonded surfaces of the base plate, the entire surface of the substrate can uniformly be heated and heat response is superior to thereby easily control a temperature, compared with the related art in which a partially-contact portion is previously heat-conducted and the non-contact portion is heat-conducted later. This effect is obvious when the base plate is larger as the substrates are larger. Furthermore, compared with the related art in which the upper and lower bonded surfaces of the base plate are fabricated to be completely planed, the operation for fabricating the completely planed bonded surfaces is not required in the present invention, which results in remarkable reduction of the fabrication cost for the base plate.

In the present invention according to claim 2, in addition to the effect of the present invention according to claim 1, the upper portion and the lower portion of the base plate have the same condition by arranging the heating unit and the cooling unit therebetween, and thus a temperature difference between upper and lower portions of the base plate does not occur by heating and cooling, which results in completely preventing deformation of the base plate due to the change of temperature.

[Brief Description for the Drawing]

Figure 1 is a longitudinal sectional view showing an apparatus for

fabricating a liquid crystal display panel according to an embodiment of the present invention, wherein Figure 1(a) shows a state before decompression and Figure 1(b) shows a state when the substrates are pressurized by the decompression.

Figure 2 is a cross-sectional view taken along the line (2)-(2) in Figure 1(a).

Figure 3 is a longitudinal sectional view showing an apparatus for fabricating a liquid crystal display panel according to another embodiment of the present invention, which shows the state before decompression.

Figure 4 is a longitudinal sectional view showing an apparatus for fabricating a liquid crystal display panel according to the other embodiment of the present invention, which shows the state before decompression.

[Explanation for Reference Symbol]

A, B substrate, C adhesive, 1 base plate, 2 heating unit, 3 cooling unit